

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Ling-Chi LIAW et al.

Group Art Unit: 1763

Serial Number: 10/620,560

Examiner: OLSEN

Filed: 17 July 2003

For: **SOLUTIONS AND PROCESSES FOR REMOVAL OF SIDEWALL
RESIDUE AFTER DRY ETCHING**

REPLY BRIEF UNDER 37 C.F.R. § 41.41

MAIL STOP:
APPEAL BRIEF-PATENTS
Commissioner for Patents
Box 1450
Alexandria, Virginia 22313-1450

SIR:

In response to the Examiner's arguments presented in the Examiner's Answer dated 22 February 2008, the Appellants submit the following Reply Brief under 37 CFR 1.193(b). The new points of argument made in the Examiner's Answer are specifically identified below:

(1) Ohnishi adds fluorosulfuric acid to sulfuric acid in order to generate HF by the reaction with water molecules that are present in the solution. With regards to Figure 3 and col. 5, lines 4-9 of Ohnishi, Appellants previously noted that the etching results for HF and HSO_3F ("fluorosulfuric acid") are not the same. If the $\text{HF} + \text{H}_2\text{SO}_4$ were in equilibrium with $\text{HSO}_3\text{F} + \text{H}_2\text{O}$, the curves would be identical or at least parallel (due to differences in concentrations). As clearly depicted, equilibrium is not reached. Appellants contend that there is a difference between starting with HF and starting with HSO_3F .

In response, on page 10 of the Answer the Examiner states:

".... It is essential to realize that the line representing the HSO_3F data

is generated from only two data points. At time = 0, the data points for HSO_3F and HF differ. However, at time = 1 hour, the two points have converged, that is to say the etching result for HSO_3F is identical to the result from HF at the 1 hour mark. Furthermore, the extrapolation of the HSO_3F line beyond the 1-hour time marker represents pure (and dubious) speculation. Given the above noted $\text{HSO}_3\text{F} + \text{H}_2\text{O} \rightleftharpoons 4 \text{H}_2\text{SO}_4 + \text{HF}$ reaction dynamic, it is reasonable to expect an extrapolated HSO_3F line to tail off and become coincident with the HF line. As shown at the 1 hour mark, and as stated by appellant, if the $\text{HF} + \text{H}_2\text{SO}_4$ were in equilibrium with $\text{HSO}_3\text{F} + \text{H}_2\text{O}$, the curves would be identical or at least parallel. "

As the Examiner correctly notes, the HSO_3F and HF lines converge at one hour. However, the claims require the solution to be effective to remove sidewall residue. Thus, the appropriate point to compare the behavior of HSO_3F and HF is at the time sidewall residue is removed, which is much earlier than one hour. For example, Ohnishi conducts a 5-10 minute cleaning process (col. 8, lines 5-13). As can per claim 16, Appellants conduct a 10 minute cleaning process. A skilled worker would not etch for one hour, and even if they did, the etching behavior in the first hour is not the same (as shown in fig. 3). A skilled worker would expect longer etching times to damage the Poly-Si and bottom SiO_2 layer. See, for example, page 6 of Appellant's specification. See also claim 18, where the etch rate of the wafer is less than 1 Å/min.

Thus, a single point of convergence at one hour does not show that the behavior of $\text{HF} + \text{H}_2\text{SO}_4$ is the same as $\text{HSO}_3\text{F} + \text{H}_2\text{O}$ at the time effective for removal of sidewall residue. HSO_3F and HF do not etch in the same manner.

2) In the Answer, for the first time, the Examiner presents numerous calculations of possible interpretations of the Ohnishi solution and arrives at various ratios. Ohnishi's solution is formed by adding 1% hydrofluoric acid to a liquid mixture with a 5:1 ratio of sulfuric acid: hydrogen peroxide (col. 7, line 38-41). The Examiner's numerous calculations of possible ratios gloss over the significant fact that Ohnishi does not teach how much of the 1% HF is added to the H_2SO_4 : H_2O_2 mixture. Nor does Ohnishi disclose whether weight, volume or mole ratios are to be used. Thus, it is impossible to determine the ratio of HF to H_2SO_4 : H_2O_2 in the final mixture. Ohnishi's teaching is so ambiguous a skilled worker would not be motivated to experiment to determine a scenario that may or

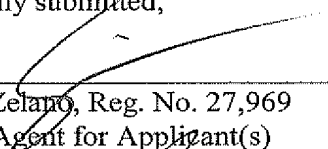
may not work. Lacking in sufficient detail, a skilled worker would simply discount the teaching as ambiguous from the start.

Without knowing how much of the 1% HF solution was added to the H₂SO₄:H₂O₂ mixture it is impossible to know the final amount of HF in Ohnishi's comparative example.

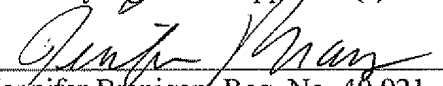
For the reasons provided above, reversal of the rejection under 35 U.S.C. §102/103 is respectfully requested.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,



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